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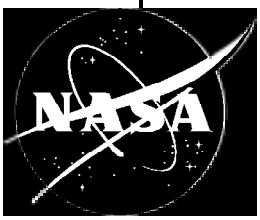
MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

Earth Observing System (EOS)
Data and Information System (EOSDIS)
Backbone Network (EBnet)
Interface Requirements Document (IRD)

September 1997

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Preface

This document in under configuration management of the National Aeronautics and Space Administration (NASA) Communication (Nascom) and Earth Science Data Information System (ESDIS) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB and ESDIS CCB along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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Abstract

This Interface Requirements Document (IRD) identifies the EBnet users, briefly characterizes their use of EBnet, and describes the external data transport interfaces that will be supported.

The specific quantitative information defines the external data transport interfaces (e.g., protocols and standards) the EBnet system will support with users.

Keywords: *EBnet, EOSDIS Backbone Network, interface, Level II, Mission Operations and Data Systems Directorate, MO&DSD, ESDIS*

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Section 1. Introduction

1.1 Authority

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement the EBnet. This authority was granted to the MO&DSD by the ESDIS project. The EBnet project is under the NASA Communications (Nascom) division of MO&DSD. Accordingly, this document is approved by the Mission Systems Networks Manager and controlled by the Nascom Configuration Control Board (CCB) and Earth Science Data and Information System (ESDIS) CCB and concurred with by all interfacing parties.

1.2 Purpose

The purpose of this document is to describe the user data transport interfaces (e.g., protocols and standards) supported by EBnet and to specify the requirements that users must meet.

1.3 Scope

This document specifies the Interface Requirements for EBnet and specific user interface requirements at the three lowest layers (e.g., physical, data link, and network layers) of the International Organization for Standardization (ISO) 7-Layer Reference Model for Open System Interconnection (OSI).

The applicable standards contain many options and implementation alternatives. Detailed options and alternatives associated with each standard protocol will be jointly identified and documented by the EBnet project and users in Interface Control Documents (ICDs). Voice requirements are detailed in the EOS Detailed Mission Requirements (DMR) documents.

1.4 Document Organization

This document is organized as follows:

- Section 2 lists applicable documents.
- Section 3 describes EBnet.
- Section 4 describes the requirements for EBnet interfaces.
- A list of abbreviations and acronyms and a glossary are provided at the end of the document.

1.5 Information Format

Section 2 lists applicable documents. The document numbers are indicated within brackets, [ ], where they are referenced (after Section 2). The requirements are presented in Section 4. Supplemental information in Section 4 is enclosed within braces, { }, to distinguish the

requirements from informational text. This supplemental information is included to help the readers fully understand the environment in which the requirements apply.

The first occurrence (subsequent to Sections 1 and 2) of each glossary entry is underlined.

The verb “will” is used in each EBnet capability statement. Where necessary, to avoid confusion, the phrase, “will provide the capability,” is used.

The verb “shall” is used in each user requirement statement. Where necessary, to avoid confusion, the phrase, “shall provide the capability,” is used.

Section 2. Applicable Documents

The following documents are incorporated by reference into this document to the extent they are applicable to the generic transport service interfaces.

2.1 Source Documents

[1] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements, Volume 6 EOSDIS Backbone Network (EBnet) Requirements*, Revision A, December 1996

[2] *Implementing Arrangement between the National Aeronautics and Space Administration of the United States of America and the Ministry of International Trade and Industry of Japan concerning Cooperation on the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Program*, November 7, 1996

[3] *Project Implementation Plan Volume II, Ground Data System, Advanced Spaceborne Thermal Emission and Reflection Radiometer, and ESDIS and EOS-AM Projects*, 505-10-111, July 1996

2.2 Reference Documents

2.2.1 Physical Layer (Layer 1)

[4] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[5] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchang*e, EIA 449, November 1977

[6] *Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 1: Physical Layer Protocol (PHY)*, ISO 9314-1, April 1989

[7] *Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 3: Physical Layer Medium Dependent (PMD) Requirements*, ISO 9314-3, First Edition, October 1990

[8] *Information Processing Systems - Local Area Networks - Part 3: Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer Specifications*, ISO 8802-3, 1993.

[9] *High Speed 25-pin Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment*, EIA 530, March 1987

[10] *Recommendation X.21 - Interface between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for synchronous operation on public data networks*, September 1992

2.2.2 Data Link Layer (Layer 2)

[11] *Information Processing Systems - Local Area Networks - Part 2: Logical Link Control,* ISO 8802-2 Second Edition, 1992

[12] *Information Processing Systems - Local Area Networks - Part 3: Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer Specifications,* ISO 8802-3, 1993

[13] *Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 2: Token Ring Media Access Control (MAC),* ISO 9314-2, First Edition, May 1989

[14] *The Point-To-Point Protocol (PPP),* RFC 1661, July 1995

2.2.3 Network Layer (Layer 3)

[15] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, RFC 791, September 1981

[16] *A Standard for the Transmission of IP Datagrams over IEEE 802 Networks,* RFC 1042, February 1988

[17] *Transmission of IP and ARP over FDDI Networks,* RFC 1390, January 1993

2.2.4 Other

[18] *NASA Access Protection Policy*, Revision 3, GSFC, November 1995

[19] EBnet Traffic Database, Nascom, January 1997, including changes through EBnet Traffic CCR #15

Section 3. EBnet Description

3.1 Overview

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. Real-time data includes mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as prelaunch testing and launch support. Science information includes data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data.

In addition to providing the wide-area communications through common carrier circuits for internal EOSDIS communications, EBnet serves as the interface to other systems such as Distributed Active Archive Centers (DAACs), users, and the NASA Internet (NI).

Key functional objectives of EBnet are:

- Transport - EBnet must provide means to transport spacecraft forward and return data between the EOSDIS Core System (ECS) and EOS Data and Operations System (EDOS) and to transport science data between DAACs.
- Network Management - EBnet must enable and assure on a system-wide basis the management of system resources and system operations.

The EBnet Traffic Database [19] contains the functional data flows associated with each interface including physical source and receiver of the interface, numeric data flow designation, instrument supported, data type supported, data flow designation and communications link (i.e., real-time, science) type supporting each interface.

The Earth Science Data Information System (ESDIS) Project Level 2 Requirements, Volume 6 EOSDIS Backbone Network (EBnet) Requirements, [1] contains the pertinent performance and availability requirements.

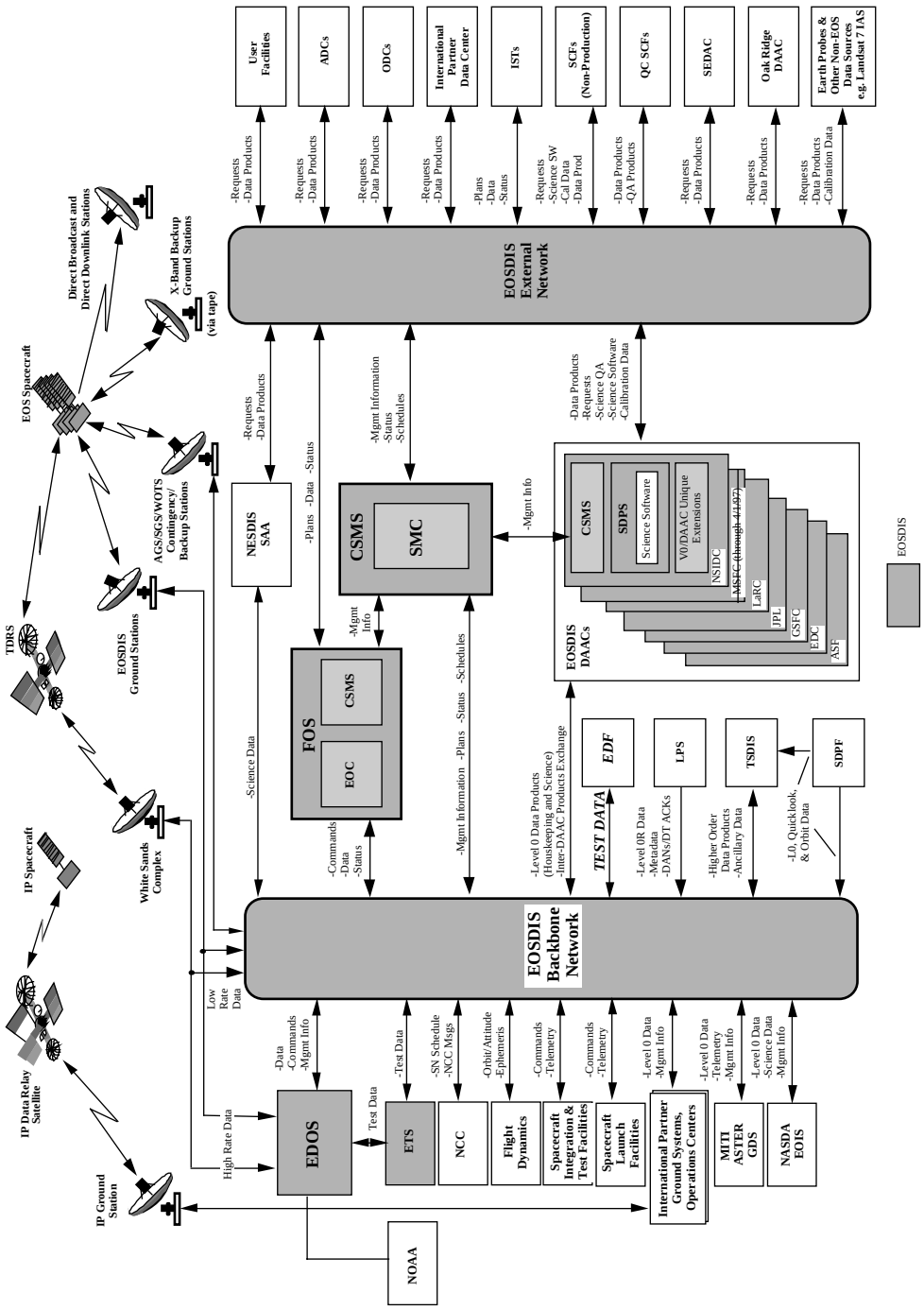


Figure 3-1. EOS Ground System

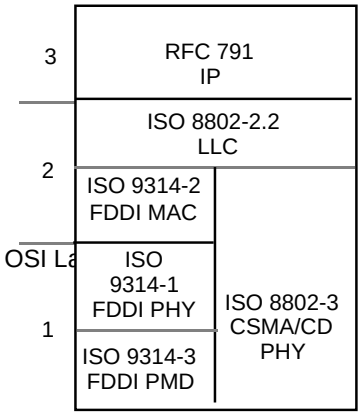
Section 4. Interface Requirements

4.1 EBnet Transport Services and Interface Options

{EBnet is an IP network. It is based on the use of standard IP access methods and protocols. EBnet provides different transport services to users based upon availability requirements. These requirements are characterized by two parameters: Operational Service Availability (A_O) and Mean Time To Restore Service (MTTRS). There are two types of transport service currently defined for EBnet: Real-time service (A_O of .9998 and MTTRS of 1 minute) and Science service (A_O of .98 and MTTRS of 4 hours). The Network Management System provides network status interface (A_O of .96 and MTTRS of 4 hours). The Alaska and Norway Ground Stations utilize science service level of availability to transport real-time data. }

{EBnet provides three options for accessing the IP based EBnet transport services: Local Area Network (LAN) Ethernet, LAN FDDI, and Wide Area Network (WAN) carrier service. Figure 4-1 provides an overview of the LAN protocol user option. Detailed user interface designs shall be documented in the EBnet ICD. This IRD describes EBnet user IP interface requirements in terms of the access options discussed above and defines locations which require IP interface support. Users and the EBnet project will coordinate the assignment of IP addresses.}

{In addition to the IP based services defined above, the EBnet project will utilize existing Nascom services where appropriate. This IRD defines the locations which require EBnet support.}



Protocol Stack

Figure 4-1. EBnet Interface Protocol

4.2 General Requirements

4.2.1 Security

4.2.1.1 EBnet shall comply with the requirements of the Nascom Access Protection Policy and Guidelines [18].

4.2.1.2 EBnet users shall comply with the EOSDIS Security Policy and Guidelines document.

4.2.2 User Interface Equipment

4.2.2.1 All physical connections between the user site communication system and EBnet shall be made at interface panels located at an EBnet demarcation point negotiated by the user and EBnet. All communication equipment (e.g., cables, hubs, concentrators, routers, etc.) from the user site equipment to the user side of the demarcation point is the responsibility of the user. The demarcation point is defined in the user-specific ICD.

4.2.3 Interface Performance

4.2.3.1 Performance requirements for EBnet interfaces are contained in the EBnet Traffic Database [19].

4.3 LAN Interfaces

{EBnet offers two types of LAN interface: Ethernet and FDDI. Each interface type has unique requirements at the Physical, Data Link, and Network layers (layers 1, 2, and 3) of the OSI seven layer reference model.}

4.3.1 LAN Physical Layer

4.3.1.1 Users shall comply with the Ethernet physical layer standard [8] when accessing EBnet via an Ethernet LAN.

4.3.1.2 Users shall comply with the FDDI physical layer standards [6 and 7] when accessing EBnet via an FDDI LAN.

4.3.2 LAN Data Link Layer

4.3.2.1 Users shall comply with the Ethernet data link layer standards [11 and 12] when accessing EBnet via an Ethernet LAN.

4.3.2.2 Users shall comply with the FDDI data link layer standards [11 and 13] when accessing EBnet via an FDDI LAN.

4.3.3 LAN Network Layer

4.3.3.1 Users shall comply with the Ethernet network layer standards [15 and 16] when accessing EBnet via an Ethernet LAN.

4.3.3.2 Users shall comply with the FDDI network layer standards [15 and 17] when accessing EBnet via an FDDI LAN.

4.4 WAN Interfaces

{EBnet offers WAN interfaces via standard common carrier circuits. These circuits can be either 56 Kbps, 64 Kbps, Fractional T1, T1, or T3.}

4.4.1 WAN Physical Layer

4.4.1.1 Users shall comply with at least one of the following physical layers when accessing EBnet via a common carrier circuit: RS-449 [5], RS-530 [9], X.21 [10].

4.4.1.2 Users shall comply with RS-422 [4] when using RS-449 or RS-530.

4.4.2 WAN Data Link Layer

4.4.2.1 Users shall conform to the PPP [14] when accessing EBnet via a common carrier circuit.

4.4.2.2 If a user selects the same router vendor that EBnet selects, EBnet will support the proprietary data link protocol implemented by that router vendor.

4.4.3 WAN Network Layer

4.4.3.1 Users shall comply with appropriate network layer standards [15] when accessing EBnet via a common carrier circuit.

4.5 EBnet Network Management Interface

{EBnet contains a network management function. This network management function provides status to ECS. This section defines the requirements for this interface.}

4.5.1 EBnet to ECS Management Interface

4.5.1.1 EBnet will exchange network management information with the System Management and Coordination Center (SMC).

4.6 EBnet IP Interface Locations

{EBnet provides IP interfaces to many different systems at many different locations. This section defines all locations where EBnet has IP based user interfaces.}

4.6.1 NASA Centers

4.6.1.1 EBnet will provide IP interfaces at GSFC, Greenbelt, Maryland, in support of the following systems:

a. EOS Operations Center (EOC).

b. GSFC DAAC.

c. SMC.

d. Flight Dynamics Division (FDD).

e. Tropical Rainfall Measuring Mission (TRMM) Science Data and Information System (TSDIS).

f. EDOS.

g. EOSDIS Test System (ETS).

h. Spacecraft Analysis System (SAS).

i. Spacecraft Simulator (SSIM).

j. Flight Software Testbed (FSTB).

k. TRMM Support System (TSS).

l. Network Control Center (NCC).

4.6.1.2 EBnet will provide IP interfaces at the Langley Research Center (LaRC), Hampton, Virginia, in support of the following systems:

a. LaRC DAAC.

b. LaRC TRMM Information System (LATIS).

4.6.1.3 Reserved.

4.6.1.4 EBnet will provide IP interfaces at the White Sands Complex (WSC), Las Cruces, New Mexico, in support of the EDOS.

4.6.1.5 EBnet will provide IP interfaces at the Jet Propulsion Laboratory (JPL), Pasadena, California, in support of the following systems:

a. JPL DAAC.

b. ASTER Instrument Support Terminal (IST).

4.6.1.6 EBnet will provide IP interfaces to Wallops Orbital Tracking System (WOTS), Wallops Island, Virginia in support of the following systems:

a. WOTS.

b. METEOR.

4.6.2 Affiliated Data Centers

4.6.2.1 EBnet will provide IP interfaces at the National Oceanic and Atmospheric Administration (NOAA), Suitland, Maryland.

4.6.3 Non NASA Centers

4.6.3.1 EBnet will provide IP interfaces at the Earth Resources Observation System (EROS) Data Center (EDC), Sioux Falls, South Dakota, in support of the following systems:

a. EDC DAAC.

b. Landsat Processing System (LPS).

4.6.3.2 EBnet will provide IP interfaces at the National Snow and Ice Data Center (NSIDC), Boulder, Colorado in support of the NSIDC DAAC.

4.6.3.3 EBnet will provide IP interfaces at the Alaska Synthetic Aperature Radar (SAR) Facility (ASF), Fairbanks, Alaska in support of the ASF DAAC.

4.6.3.4 EBnet will provide IP interfaces at the Alaska Ground Station at Poker Flats, Alaska.

4.6.4 International Partners

4.6.4.1 EBnet will provide IP interfaces at the Earth Remote Sensing Data Analysis Center, Tokyo, Japan in support of the ASTER Ground Data System (GDS), according to [2] and [3].

4.6.4.2 EBnet will provide IP interfaces at the National Space and Development Agency (NASDA), Hatoyama, Japan.

4.6.4.3 EBnet will provide IP interfaces at Norway Ground Station, Svalbard, Spitsbergen.

4.6.5 Contractor Facilities

4.6.5.1 EBnet will provide IP interfaces at the Lockheed-Martin Spacecraft Integration and Test Facility (SCITF) in support of the following systems:

a. SSIM.

b. Software Development Facility (SDF).

c. Ground Support Equipment (GSE).

4.6.5.2 EBnet will provide IP interfaces at the Hughes ECS Development Facility (EDF), Landover, Maryland in support of the following systems:

a. EDF Mini DAAC.

b. EDF Verification Acceptance Test Center (VATC) DAAC.

c. EDF Mini-EOC.

4.7 EBnet Clock and Data Interface Locations

{EBnet provides clock and data interfaces to several systems at several different locations. This section defines all locations where EBnet has clock and data based user interfaces.}

4.7.1 NASA Centers

4.7.1.1 EBnet will provide clock and data interfaces at GSFC, Greenbelt, Maryland, in support of EDOS.

4.7.1.2 Reserved.

4.7.1.3 EBnet will provide clock and data interfaces at the WSC, Las Cruces, New Mexico in support of the following systems:

a. EDOS.

b. White Sands Ground Terminal (WSGT).

c. Second Tracking Data Relay Satellite System (TDRSS) Ground Terminal (STGT).

4.7.2 Other Government Centers

4.7.2.1 EBnet will provide clock and data interfaces at the Vandenburg Air Force Base (VAFB), Lompoc, California, in support of the Spacecraft Checkout Station (SCS).

4.7.2.2 EBnet will provide clock and data interfaces to the EOS Polar Ground Station (EPGS) located at Poker Flats, Alaska, in support of the following systems:

a. EDOS.

b. Alaska Ground Station (AGS).

4.7.3 Contractor Facilities

4.7.3.1 EBnet will provide clock and data interfaces at the Lockheed-Martin SCITF, Valley Forge, Pennsylvania, in support of the following systems:

a. SCS.

b. SSIM.

4.7.4 International Partner

4.7.1.1 EBnet will provide clock and data interfaces to the EPGS located at Svalbard, Spitbergen, in support of following systems:

a. EDOS.

b. Svalbard Ground Station (SGS).

Abbreviations and Acronyms

ADS	Archive Data Set
A_O	Operational Service Availability
ASF	Alaska SAR Facility
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
CCB	Configuration Control Board
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
DAAC	Distributed Active Archive Center
DCE	Data-Circuit Terminating Equipment
DCN	Document Change Notice
DMR	Detailed Mission Requirement
DTE	Data Terminal Equipment
EBnet	EOSDIS Backbone Network
ECS	EOSDIS Core System
EDC	EROS Data Center
EDF	ECS Development Facility
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EIA	Electronic Industries Association
EOC	EOS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EPGS	EOS Polar Ground Station
EROS	Earth Resources Observation System
ESDIS	Earth Science Data Information System
ETS	EOSDIS Test System
FDD	Flight Dynamics Division
FDDI	Fiber Distributed Data Interface

FSTB	Flight Software Testbed
GDS	Ground Data System
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
IST	Instrument Support Terminal
JPL	Jet Propulsion Laboratory
LAN	Local Area Network
LaRC	Langley Research Center
LPS	Landsat Processing System
MAC	Media Access Control
MO&DSD	Mission Operations and Data Systems Directorate
MTTRS	Mean Time To Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NASDA	National Space and Development Agency
NCC	Network Control Center
NOAA	National Oceanic and Atmospheric Administration
NI	NASA Internet
NSIDC	National Snow and Ice Data Center
OSI	Open Systems Interconnection
PDS	Production Data Set
PHY	Physical Layer Protocol
PMD	Physical Layer Medium Dependent
PPP	Point-To-Point Protocol
QDS	Quick-look Data set

SAR	Synthetic Aperature Radar
SAS	Spacecraft Analysis System
SCITF	Spacecraft Integration and Test Facility
SCS	Spacecraft Checkout Station
SDF	Software Development Facility
SMC	System Monitoring & Coordination Center
SSIM	Spacecraft Simulator
STGT	TDRSS Ground Terminal
TDRSS	Second Tracking Data Relay Satellite System
TRMM	Tropical Rainfall Measuring Mission
TSDIS	TRMM Science Data and Information System
TSS	TRMM Support System
VAFB	Vandenburg Air Force Base
VATC	Verification Acceptance Test Center
WAN	Wide Area Network
WOTS	Wallops Orbital Tracking Station
WSC	White Sands Complex
WSGT	White Sands Ground Terminal

Glossary

A_o	see operational availability.
corrective maintenance	all actions performed as a result of failure to restore an item to a specified condition. Corrective maintenance can include any or all of the following steps: localization, isolation, disassembly, interchange, reassembly, alignment, and checkout.
element	hardware or software that can be identified as an individual item, assembly, combination of subassemblies, or software modules that have specific function.
MTTRS	The total corrective maintenance time associated with downing events divided by the total number of downing events during a stated period of time. Excludes time for off-system maintenance and repair of detached components. The MTTRS must be maintained for each EBnet user service (e.g., it is not the average across all user services).
operational service availability $\underline{A_o}$	the time service is available is measured over a availability due to loss of facility services, such as power or air conditioning, shall not be counted.
downtime,	The time service is not available shall include all times service is not available due to corrective maintenance downtime, administrative logistics supply downtime, and preventive maintenance downtime. It is determined as follows: A_o = mean time service is available / (mean time service is available + mean time service is not available)
preventive by maintenance incipient	all actions performed in an attempt to retain an item in specified condition providing systematic inspection, detection, and prevention of failures.
real-time	includes spacecraft commands, housekeeping data, housekeeping playback data, tracking data, and science telemetry.
science	science data includes Quick-look Data Sets (QDSs), Production Data Sets (PDSs), and Archive Data Sets (ADSs) transferred from the EDOS to the DAACs and between DAACs.
User/Users	Any organizational entity or group of entities that uses EBnet.